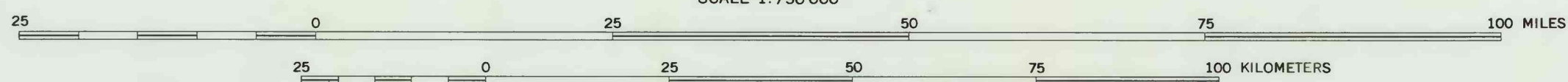


Base from U.S. Geological Survey
Data from maps: 1:50,000, Arkansas, 1957;
Kansas, 1953; Missouri, 1972; Oklahoma, 1972



Thickness of Western Interior Plains confining system

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA—WESTERN INTERIOR PLAINS CONFINING SYSTEM

By
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EXPLANATION

- Outcrop area of Western Interior Plains confining system
- Outcrop area of unnamed geohydrologic units that are stratigraphically equivalent to the Western Interior Plains confining system
- Outcrop area of rocks comprising geohydrologic units older than Western Interior Plains confining system
- Area where Western Interior Plains confining system and stratigraphically equivalent units are missing in subsurface

--- Contact—Dashed where approximately located

--- Approximate boundary of Ozark Plateaus aquifer

—1000— Line of equal thickness of Western Interior Plains confining system and stratigraphically equivalent units—Lines in areas of few control points are consistent with thickness data calculated from digital representations of altitude of top of the Western Interior Plains confining system and stratigraphically equivalent units and altitude of top of underlying Springfield Plateau aquifer and stratigraphically equivalent units. Interval, in feet, is variable

• 1130 Control data point—Part of Central Midwest Regional Aquifer-System Analysis data base. Number is thickness, in feet, of Western Interior Plains confining system and stratigraphically equivalent units

○ Auxiliary control data point

THICKNESS

The greater part of the Western Interior Plains confining system lies west of the Ozark Plateaus province, but a small strip confines the western and southern edges of the Ozark Plateaus aquifer system. In southwestern Missouri the confining system thickens at a fairly uniform rate of about 12 feet per mile to the northwest and is about 400 feet thick along the western edge of the Ozark Plateaus aquifer system. Irregularities in the thickness of the confining system near the western boundary of the Ozark Plateaus province do not appear to conform to the surface drainage pattern and probably are primarily controlled by erosional features on top of the underlying Springfield Plateau aquifer. At the Kansas-Oklahoma border the confining system is thickening at a rate of about 25 feet per mile to the west, and near the southwest edge of the Ozark Plateaus province the rate has increased to about 80 feet per mile to the southwest. The rate of thickening away from the Ozark Plateaus province becomes greater and more uniform south of the Boston Mountains where the confining system thickens at a rate of about 180 feet per mile to the south and attains a thickness of about 6,000 feet beneath the Arkansas River.

Geologic units that are stratigraphically equivalent to the Western Interior Plains confining system blanket the higher-altitude areas between river valleys in the north-central part of the Ozark Plateaus and are in direct contact with the Ozark aquifer (Chapter E). Thickness of the rocks in this area generally is less than 200 feet. A nearly circular lens of Pennsylvanian rocks in St. Louis County, Missouri, thickens to about 250 feet at the center, and a narrow slice of Pennsylvanian rocks occurs in eastern Perry County, Missouri.

GEOHYDROLOGIC PROPERTIES AND LITHOLOGY

A geohydrologic unit is characterized by its ability or inability to yield usable quantities of water to wells relative to that which is available from surrounding rocks. A thick and geologically complex unit, such as the Western Interior Plains confining system, may have the properties of an aquifer in one area or at one depth and have the properties of a confining layer at another area or depth. The designation of the Western Interior Plains confining system indicates that, on a regional scale, the rocks that comprise the confining system generally have relatively low permeability and impede the vertical flow of ground water. However, the hydraulic characteristics of individual geologic units that comprise the system, locally, may be those of an aquifer or a confining layer. The hydraulic properties of a confining system are storage and leakage coefficients. The lateral hydraulic conductivity of a confining system is much smaller than the vertical hydraulic conductivity. The storage coefficient is directly proportional to the porosity of the rocks that comprise the system.

The leakage coefficient ($L = K/b$), defined as the ratio of vertical hydraulic conductivity (K) to thickness (b), determines the rate at which water can move vertically through the confining system. The vertical hydraulic conductivity is a function of several physical properties of the geologic formations that comprise the confining system, including lithology, primary porosity of the rocks, the presence of fracture and fault systems, and physical properties of water in the confining system. Where a confining system contains a greater fraction of carbonate rocks, the development of post-depositional solution channels may significantly increase the value of vertical hydraulic conductivity. Confining layers usually, but not always, contain significant quantities of shale, a relatively impermeable material. The leakage coefficient is inversely proportional to thickness; therefore, assuming a uniform vertical hydraulic conductivity, a thicker confining unit is a more effective barrier to ground-water flow.

Within the thick Western Interior Plains confining system, many formations of younger geologic age than those that are present along the boundaries of the Ozark Plateaus province exist. In describing the lithologic properties of the Western Interior Plains confining system, only those formations that are present near the boundaries of the Ozark Plateaus province are included. The stratigraphically lowest geologic formation in this confining system is the Moorefield Formation. This formation contains a relatively impermeable shale member in northern Arkansas designated the Ruddell Shale Member. However, the limestone content and permeability of the Moorefield Formation increases to the west and the formation is assigned to the underlying Springfield Plateau aquifer in northeastern Oklahoma. The Batesville Sandstone in the Western Interior Plains confining system in a calcareous sandstone containing some shale and is relatively impermeable because the sand grains are tightly cemented. Of the remaining Mississippian formations in the confining system, the Hindsville Limestone, Fayetteville Shale, and Piken Limestone are thickest and the most extensive. The Hindsville Limestone and Piken Limestone probably contribute little to the confining nature of the Western Interior Plains confining system, but the Fayetteville Shale is thick enough and contains enough shale to restrict ground-water flow in the confining system in northern Arkansas and northeastern Oklahoma (Huffman, 1958 and Caplan, 1956). Pennsylvanian rocks that abut the western and southern boundaries of the Ozark Plateaus province predominantly are shale, sandstone, and limestone interspersed with coal beds and clay. Most of the Pennsylvanian rock units in this thick geohydrologic unit are either dominated by or contain significant quantities of shale that effectively retard ground-water flow between land surface and the underlying Springfield Plateau aquifer. Some of the larger sandstone formations, most notably those of the Cherokee Group, are permeable enough to be local aquifers within the confining system.